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Ph.D. DISSERTATION DEFENSE

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ABSTRACT

There has been a great amount of speculation on how gravity works on a quantum level, but very little experimental input. Here, we discuss how gravitons are derived from gravitational waves, how gravitational waves are detected through spacetime measurements and absorption of energy, and how gravitons can be resolved with the right kind of detector. We will compare this detector with historical detectors, both to show how the difference in methodology corresponds to greater sensitivity to gravitons as well as to indicate optimal graviton sources and detector properties. Following the detection methods, we describe how we can use these measurements to probe the properties of gravity including the quantum state of gravitational waves as well as more fundamental properties inspired by historical tests on the quantization of light. These include the graviton's energy-frequency relationship with the gravitational wave and the graviton's spin. The results of this thesis demonstrate the feasibility of near future realization of graviton detection and resulting tests that can provide a more concrete and empirical outlook on the quantum nature of gravity.